IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In re Application of: Bruce FAURE

Confirmation No. 7062

Application No.: 10/716,901

Group Art Unit: 1722

Filing Date: November 18, 2003

Examiner: R. Kunemund

For: METHOD FOR FABRICATING A CARRIER SUBSTRATE

Atty. Docket No.: 4717-12500

DECLARATION OF BRUCE FAURE
UNDER 37 C.F.R. § 1.132

Commissioner for Patents
P.O. Box 1450
Alexandria, Virginia 22313-1450

Sir:

I, Bruce Faure, hereby declare that:

1. I am a citizen of France and reside at 10 rue du vieux temple 38000 Grenoble FRANCE.

2. In 2001, I received a Master in applied sciences in electronic from Unisveristy of Sherbrooke (Canada). I am an inventor of 12 U.S. patents and patent applications that are already published or issued, and additional applications that are not yet published. I authored about 5 published articles in papers or conferences on semiconductors.

3. I am presently a **Project Manager** at S.O.I TEC SILICON ON INSULATOR TECHNOLOGIES SA. I have over 5 years of experience in the field of semiconductors and semiconductor manufacture, including silicon-on-insulator (SOI) wafers.

4. I have reviewed and understand the above-identified patent application ("the application"), the pending claims with the present amendments, the Office Action mailed on June 12, 2006 and the references cited therein. In particular, I have reviewed U.S. Patent No.

on June 12, 2006 and the references cited therein. In particular, I have reviewed U.S. Patent No. 6,150,239 to Goesele et al. ("Goesele"). I am making the following statements as one of ordinary skill in the art in support of the patentability of the claims in this application.

5. Goesele discloses growing monocrystalline materials such as gallium arsenide, gallium nitride and other III-V compounds on a monocrystalline substrate such as germanium or silicon carbide to form a first substrate (Goesele, col. 9, lines 26-38; col. 4, lines 6-12). These monocrystalline materials are chosen because they do not show surface blister formation after hydrogen implantation (col. 9, lines 26-30). Hydrogen trap inducing boron ions and hydrogen are then implanted so that the maximum concentration of boron traps and hydrogen are located in the monocrystalline substrate, thereby forming an implantation zone (col. 9, lines 38-44; col. 10, lines 8-29). A sensitizing heat treatment is performed (col. 10, lines 48-57). Thereafter, the monocrystalline first substrate is bonded to a second substrate (*e.g.*, fused quartz) such as by direct wafer bonding (col. 11, lines 1-5). The combined structure is subsequently heat treated to split the first substrate at the implantation zone and transfer a portion of the first substrate to the second substrate (col. 11, lines 5-16).

6. Claim 1 of the application recites providing a crystalline base substrate that includes a zone of weakness and growing a stiffening layer on that base substrate. This language of claim 1 goes against the teachings of Goesele.

7. Goesele specifically discloses epitaxially growing a layer(s) of monocrystalline material on a monocrystalline substrate to form a first substrate and, thereafter, forming an implantation zone (Goesele, col. 9, lines 26-44). In particular, hydrogen is implanted <u>after</u> epitaxial growth. In my opinion, one of ordinary skill in the art, reading Goesele, would not find any teaching or suggestion to epitaxially grow a layer of material on a base substrate that <u>already</u> has a zone of weakness as recited in present claim 1. Accordingly, Goesele does not disclose, teach or suggest providing a crystalline base substrate that includes a zone of weakness and thereafter growing a stiffening layer on the base substrate.

8. Goesele specifically discusses the disadvantage of methods that split substrates at temperatures higher than 500°C (Goesele, col. 2, line 63 - col. 3, line 12). Goesele

states that high splitting temperatures prevent economical application of the method to transfer monocrystalline thin layers onto a dissimilar substrate with a substantially different thermal expansion coefficient. Goesele requires the first substrate to be split at low temperatures (e.g., 200°C, 385°C) to achieve stated advantages, including the reduction of microroughness of the surface of a transferred layer as well as avoiding as much implantation induced damage as possible (col. 3, lines 37-56; col. 11, line 11; col. 12, line 46). As such, Goesele specifically teaches away from using higher temperatures for splitting. Thus, in my opinion, of ordinary skill in the art, reading Goesele, would not find any suggestion to epitaxially grow a layer of material on a base substrate that already has a zone of weakness as recited in claim 1. Epitaxially growth of a layer of material is generally performed at high temperatures (*e.g.*, between about 400°C and about 1500°C). If a monocrytalline material were epitaxially grown on a monocrytalline substrate that already has an implantation zone, the implantation zone would be exposed to high temperatures that would cause splitting therein. Accordingly, for this additional reason, Goesele does not disclose, teach or suggest providing a crystalline base substrate that includes a zone of weakness and growing a stiffening layer on the base substrate.

9. Moreover, epitaxially growing a layer of monocrystalline material on a monocrystalline substrate that already has an implantation zone would render Goesele inoperative, because splitting would occur before the epitaxial layer could be completely formed.

10. Claim 1 of the application also recites detaching the stiffening layer and carrier sublayer from the remainder of the base substrate at the zone of weakness to obtain a carrier substrate and growing a high quality, epitaxial film on the carrier substrate. In other words, claim 1 recites that the stiffening layer and carrier sublayer are separated from the remainder of the base layer *before growing* an epitaxial film on the stiffening layer. This language of claim 1 is contrary to the teaching of Goesele.

11. Goesele specifically discloses bonding a first monocrystalline substrate (having a monocrystalline epitaxial layer) to a second substrate such as fused quartz (Goesele, col. 4, lines 5-12; col. 5, lines 12-14; col. 9, lines 26-51). One of ordinary skill in the art would have understood that the second substrate of Goesele must provide the additional thickness that

is necessary to form a self-supporting structure capable of further processing. Thus, there is no need in Goesele to provide additional epitaxial growth on the monocrystalline substrate to achieve a necessary thickness to form a self-supporting structure especially since Goesele discloses only using a minimal amount of monocrystalline material. Accordingly, Goesele does not disclose, teach or suggest separating the stiffening layer and carrier sublayer from the remainder of the base layer *before growing* an epitaxial film.

12. Goesele specifically discloses epitaxially growing a layer(s) of monocrystalline material on a monocrystalline substrate to form a first substrate and, thereafter, splitting the first substrate at monocrystalline substrate (Goesele, col. 9, lines 26-44). Claim 1 of the application necessarily requires separating the stiffening layer and carrier sublayer from the remainder of the base layer to obtain a carrier substrate followed by growing a high quality epitaxial film on the carrier substrate (*i.e.*, splitting followed by epitaxial growth). Accordingly, for this additional reason, Goesele does not disclose, teach or suggest separating the stiffening layer and carrier sublayer from the remainder of the base layer *before growing* an epitaxial film. Moreover, since splitting occurs before additional epitaxial growth, the present application provides the surprising advantage of allowing additional epitaxial growth at high temperatures without concern for prematurely splitting the substrate. Epitaxially growing at high temperatures results in a high quality film.

13. Claim 24 of the application recites a surface of a carrier substrate having a surface roughness between approximately 20 Å RMS and about 200 Å RMS. Claim 28 of the application recites providing a surface roughness that is sufficient to securely hold the carrier substrate in position on the remainder of the base substrate. Claim 29 of the application recites that the carrier substrate is retained in position against the remainder of the base substrate during the growth of the high quality epitaxial film.
Goesele discusses the disadvantages of having a transferred layer with a roughness that requires additional polishing steps (Goesele, col. 3, lines 13-30). Thus, Goesele attempts to minimize surface roughness (Goesele, col. 3, lines 37-48). Claims 24, 28 and 29, on the other hand, recites just the opposite - providing a roughness which is sufficient enough to securely hold a carrier substrate is position on a base substrate during further processing of the carrier substrate (*e.g.*,

additional epitaxial growth). Such a roughness would necessitate polishing and, thus, is contrary to the Goesele. One skilled in the art, reading Goesele, would not find any suggestion to provide a surface roughness which is sufficient to securely hold the carrier substrate on the base substrate as recited in claims 24 and 28.

14. Furthermore, Goesele discloses attaching a second substrate to the first substrate having the epitaxially grown layer prior to splitting to provide support for the first substrate during splitting. The present application provides the surprising advantage of allowing additional epitaxial growth without the need to bond to another substrate to provide a self-supporting structure. Goesele does not suggest retaining a substrate in position against the remainder of a base substrate after splitting as recited in claim 29. Accordingly, Goesele does not disclose, teach or suggest a surface roughness that is sufficient to securely hold the carrier substrate on the base substrate or retaining a carrier substrate in position against the remainder of the base substrate after splitting.

15 I further declare that all statements made herein of my knowledge are true and all statements made on information and belief are believed to be true; and further that these statements are made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under Section 1001 of Title 18 of the United States Code and that such willful false statements may jeopardize the validity of this application or any patent issuing thereon.

Dated this 5th day of December, 2006.

Declarant:

Bruce Faure